Dr. Feast. You know I'm going back [to Pretoria] next week and the proof of the pudding is in the eating.

Dr. J. C. Jackson. What is the gain of speed on extended objects?

Mr. Milsom. This spectrograph was not designed specifically for extended objects. It would be desirable to have an instrument in which we could open the slit wider than we would normally use for a stellar source, and in doing so with this particular spectrograph we would lose spectral resolution. To observe extended objects more effectively we would have to design a spectrograph for that purpose.

A Visitor. What type of film are you using for the spectrograph, stripping emulsion or Melinex?

Mr. Milsom. We have been using Melinex base, although some of the plates I took were on stripping emulsion, which is really preferable.

Professor Redman. Is there any variation in positional accuracy in stripping emulsion?

Mr. Milsom. With the techniques which have been developed at Imperial College for handling stripping emulsion, the stability is reasonably high. I have no figures.

Professor Fowler. The emulsion is remounted on glass?

Mr. Milsom. Yes. Also, the comparison spectrum is placed as close as possible to the stellar spectrum.

Professor McGee. There is not much to choose, in my experience, between the dimensional stability of film with thin Melinex backing, and that of stripping emulsion replaced on glass. In each case, the stability is about one part per thousand.

NOTES FROM OBSERVATORIES

A Precision Sidereal Telescope Drive Based on a Solar Time Crystal Clock

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A requirement arose for a sidereal drive for a small microwave radiometer on an equatorial mount, the equipment to run unattended to a precision of about 2 minutes in hour angle over a 7-day period. The installation already included a solar-time crystal clock based on a 10 MHz oscillator (type HCD 25), which through decade scalers could easily be arranged to operate a standard 50 Hz synchronous motor which would drive the mounting at one revolution per solar day. However, no suitable gearing was available to generate the required sidereal rate.

The principle of the electronic system described here is derived from the type of vernier timing system described by Horowitz[1] for generating precise periodicities in work on pulsars, a system which in different forms has been used very successfully by groups at A.E.R.E.[2], at the Smithsonian Institution[3], and elsewhere, in various pulsar studies.

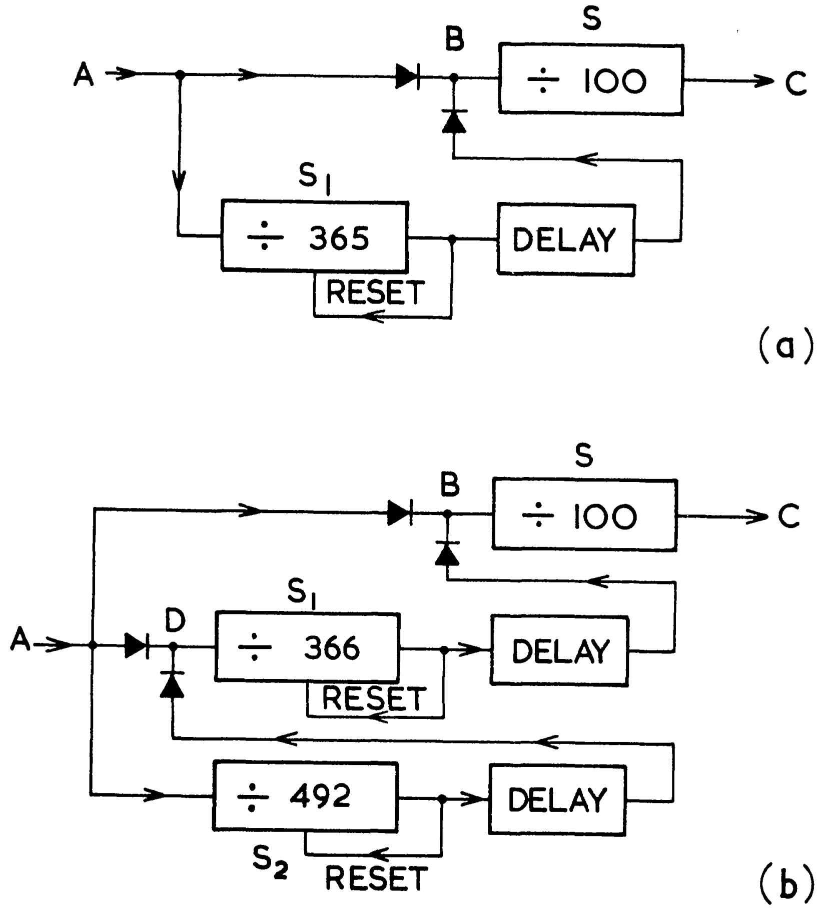

FIG 1

The essential features of an elementary system are shown in Fig. 1 (*a*). The output of the 10 MHz crystal oscillator is scaled by a factor of 1000 to produce 0·5 μs pulses at a repetition rate of 10 kHz, at point A. A preset scaler S_1, arranged to give an output pulse and reset itself after every 365 input pulses, injects occasional additional pulses into the system, so that at B the *mean* pulse rate is $10(1+1/365)$ kHz. A further decade scaler S, set to divide by a factor of 100, therefore generates pulses at C at a mean rate close to 100 Hz sidereal. These are then passed to a bistable which, via power transistors and a transformer, drives a 240 v 50 Hz synchronous motor with a 1 rpm output shaft (Everett Edgecombe Synclock type CXM). The scaler S ensures that the non-uniform pulse rate at B is sufficiently smoothed not to disturb the synchronism of the motor. It is necessary that the path through S_1 should involve sufficient delay that the occasional double pulses at B are resolved by the input circuit of S, and with some scalers an additional delay may be required. With this simple arrangement a sidereal rate of 1·0027397 times the solar rate is obtained. This is more than adequate for our particular application, since the error from the true ratio of the rates (sidereal/solar), 1·002737797, is only 2 parts in 10^6. The ratio quoted here is that of the period of rotation of the Earth referred to the fixed stars, corrected to the epoch 1971·5[4].

If higher accuracy is required, a second preset scaler S_2 may be added to form a vernier system, as in Fig. 1 (*b*). If the numbers preset in the two scalers are N_1 and N_2, then the ratio of mean pulse rates at B and A becomes $[1+(1+N_2^{-1})N_1^{-1}]$. With $N_1 = 366$ and $N_2 = 492$ we obtain a ratio of 1·002737793 which now differs from the (sidereal/solar) ratio above by only 4 parts in 10^9. This error is less than atmospheric refraction corrections and, almost certainly, imperfections in the mechanical drive; and in our specific case it is comparable with or less than drifts in the crystal itself.

We note that we obtain this very high accuracy with only two preset scalers and, moreover, that each of these need contain only three decades. Suitable scalers are available commercially (some under the name of "batch counters") or can be assembled from integrated circuits as described by Horowitz. In our own equipment all the scalers are standard units from the Harwell 2000 Series of electronics developed for nuclear instrumentation.

References

(1) P. Horowitz, *Rev. Sci. Inst.*, **40**, 369, 1969.

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REVIEWS

Transactions of the International Astronomical Union, Volume XIV A: Reports on Astronomy, edited by C. de Jager. (D. Reidel Publishing Company, 1970.) Pp. 566. Price f65 (£5·00).

The present *Reports on Astronomy* is the first of a new breed of IAU Transactions resulting from the conflict between publication costs on the one hand and the increasing flood of astronomical research on the other. It contains the reports of the thirty-eight commissions, prepared immediately before the XIVth General Assembly, and thereby replaces the previous collection of draft reports, but in greatly compressed form. It was this drastic pruning, particularly with regard to reference lists, that prompted a reviewer of the previous Reports to suggest that it might be the last such volume of any "permanent value", and, unfortunately, I found this fear to be largely substantiated. Most commission presidents bemoan the loss of their references although a few chose to ignore the edict and include sizeable bibliographies in list form or, more subtly, as part of the text. If the ruling is enforced in future, I suspect many commissions will follow the example of Commission 33 and prepare more detailed tracts for their own members, the ultimate result being the circulation of individual reports among interested astronomers and the redundancy of an "official" compilation. This would be a great pity because *Reports on Astronomy* is capable of giving workers an